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Water Quality Index and Microbial Population Assessment for Ground Water

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Abstract

Pollution of water sources have become a common Environmental problem these days, be it groundwater source or surface water sources. The most important and major usage of groundwater is for irrigation. Unfortunately, groundwater is susceptible to pollutants that may enter into the subsurface groundwater by runoff. The presence of microbes in drinking water is now common problems as the majority of the groundwater sources are substantially polluted. The physicochemical and microbial properties of water were studied, and it was found that the treated water sample showed a better water quality rating than the raw sample. E.coli are indicators of microbial pathogens it indicates the presence of fecal contamination in the water.

Keywords: *E.coli removal; Faecal contamination; Water quality Index.*

1. INTRODUCTION

The basic needs of any human being can be classified under three heads Food, Shelter and clean drinking water. Pollution of water sources has become a common problem these days, be it groundwater source or surface water sources these problems are more common in developing countries than in developed countries. The main source of pathogens in drinking water is through recent contamination from human or animal waste, and the contamination sources are of three types

• Leaching of animal manure • Stormwater runoff • Domestic animals or wildlife

In some of the developing nations, the major sources of freshwater are getting polluted due to inefficient waste management practices and obsolete waste management strategies. Major factors affecting the microbiological quality of surface waters in India are

- Discharges from sewage Open defecation Runoff from informal settlements

The most common symptoms of waterborne illness include1 nausea, vomiting, and diarrhoea. According to the W.H.O Report, about 80 % of most sickness is caused due to inadequate sanitation, polluted water (Sivaraja *et al*, 2014). In general, the water intended for the domestic purpose shall not contain *e.coli* in a 100 ml sample.

2. MATERIAL & METHODS

The water samples from the study area were collected in which one sample was a raw sample, and the other sample was a treated sample, and 10 physicochemical parameters were analyzed for the samples using the standard set of procedures. The results of various physicochemical parameters done for the samples are tabulated as follows. The tabulated values of various water quality parameters for both the given samples are represented in a graph below, indicating the change in water quality parameters between both the samples raw sample and treated sample

Table 1. Result of Physico Chemical Parameters

S.No	Parameters	Standards	Raw Sample	Treated sample
1	Ph	6.5 – 8.5	8.2	6.8
2	Turbidity in mg/l	-	0.42	0.05
3	Total Dissolved solids in mg/l	500	102	65
4	Total Hardness in mg/l	300	48	18
5	Total Alkalinity in mg/l	120	54	12
6	Calcium in mg/l	75	10.98	5.61
7	Sulphates in mg/l	150	35.78	27.50
8	Magnesium in mg/l	30	2.67	0.98
9	BOD in mg/l	5.0	4.3	1.2
10	COD in mg/l	5.0	6.8	4.2

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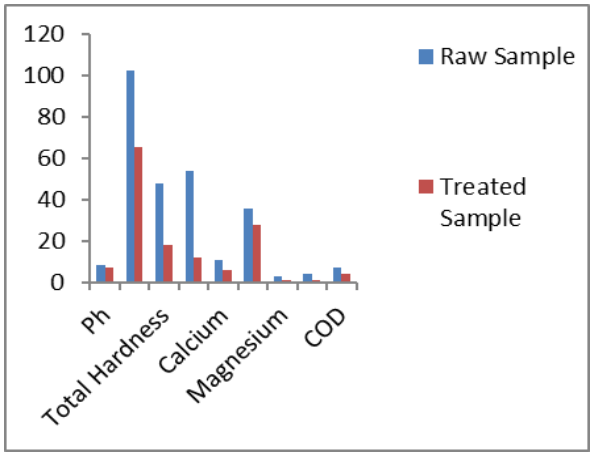

Water Quality Index (WQI) denotes the water quality and represents the overall quality of water based on the index number. In this study, WQI has been calculated by assessing a set of Water quality parameters. The calculation of WQI was made using weikghed Arithmetic index method (Brown et al.1972) further the calculation of Sub Index was also done from the expression $\mathbf{q_n=100\ (v_n-v_i)\ /\ (v_s-v_i)}$

WQI is calculated by the following equation.

$$WQI = \frac{\sum_{n=1}^{n} q_n.W_n}{\sum_{n=1}^{n} W_n}$$

Where, $\mathbf{W_n= k/S_n,}$ w_n = unit weight S_n = standard permissible value k = proportionality constant.

The WQI values for human consumption as per the norms are as follows.

- 0-25 ……. Excellent 26-50 … Good 51-75 …. Bad 76-100 …. Very Bad

WQI for Sample 1 $(WQI)_1 = \frac{\sum_{n=1}^{n} q_n.W_n}{\sum_{n=1}^{n} W_n} = \frac{31.074}{0.71} =$ **84.16**

WQI for Sample 2 $WQI = \frac{\sum_{n=1}^{n} q_n.W_n}{\sum_{n=1}^{n} W_n} = \frac{31.074}{0.71} =$ **43.76**

This method is based on the principle that when a sample containing bacterial population is inoculated in a suitable medium (Vignesh et al 2013) each viable cell will develop into the colony hence a number of colony appearing on the plate represent the amount of a bacterial population present in the sample and were then incubated for a period of 48 hours after which the species polluting the water sample was identified as e.coli by the shape and gram staining. Then the samples were incubated and were assessed for the microbial population in a colony counter, the results of which are given below in table 3.

Table 2. Water Quality Index For Both Samples

S.No	Parameters	Observed Value (V_n)	Standard Value (S_n)	Unit weight (K)	$(Q_n)_1$	$(W_n.Q_n)_1$	$(Q_n)_2$	$(W_n.Q_n)_2$
1	Ph	8.2	6.5-8.5	0.2190	117.14	25.65	97.14	21.278
2	Total Dissolved Solids	102	500	0.0037	20.4	0.075	13.00	0.048
3	Chlorides (Cl_2)	10	250	0.0074	4	0.030	1.92	0.014
4	Magnesium (Mg)	2.67	30	0.061	8.9	0.543	3.27	0.200
5	Total Hardness	48	300	0.0062	16	0.099	6.00	0.037
6	Total Alkalinity	54	120	0.0155	45	0.70	10.00	0.155
7	Calcium (Ca)	10.98	75	0.025	14.64	0.366	7.48	0.187
8	Sulphates (Su)	35.78	150	0.0124	23.85	0.30	18.33	0.227
9	BOD	4.3	5.00	0.372	86	31.99	24.00	8.928
				$\sum W_n$ = 0.71		**$\sum W_n .q_n$ = 59.753**		**$\sum W_n .q_n$ = 31.074**

Table 3. Microbial Population Assessment

S.No	Samples	TVC	TC	TS
1	Sample 1	15.2 x 10^3	6.2 x 10^2	1.4 x 10^2
2	Sample 2	13.6 x 10^3	7.1 x 10^2	0.9 x 10^2

TVC – Total viable count; TC – Total coliforms; TS – Total Streptococci

3. CONCLUSION

The water quality index of the present samples was calculated from various physicochemical parameters, which are listed in Table 1. The water quality rating of the samples clearly shows that of the two samples taken up for the study, the raw sample though less polluted, is still unsuitable for human uses.

The above water quality rating is supported by water quality parameters, as pH is a major parameter and determines the usage of the water. In this study pH of the raw sample was nearer to 8 and was alkaline, and the treated sample was closer to neutral, and the other parameters are well within the acceptable limits other than COD though the COD of the raw sample was higher it is within the acceptable limits in the treated water sample. The groundwater sample is also found to be contaminated by *e.coli*. Though the levels of *e.coli* are comparatively low in the treated samples, the concentration of the pathogen wasn't completely nil.

From the study, it has been found that the preliminary treatment employed is effective in the reduction of pH and other such characteristics to a considerable extent, especially for groundwaters which has a low hardness scale, and also the usage of the Water Quality Index (WQI) has been found to be an effective method to assess the overall quantity of water for human consumptive purposes.

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